IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of: **CAIN ET AL.**	Examiner: H. Nguyen
Serial No. **10/658,022**	Art Unit: 2662
Confirmation No. **2811**	
Filing Date: **SEPTEMBER 9, 2003**	
For: **MOBILE AD HOC NETWORK (MANET) WITH QUALITY-OF-SERVICE (QOS) PROTOCOL HIERARCHY AND RELATED METHODS**	

RESPONSE

MS Amendment
Commissioner of Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Responsive to the Official Action of December 21, 2005, please enter the amendments and remarks set out below.

In the Claims:

1. (Previously presented) A mobile ad hoc network (MANET) comprising:

a plurality of mobile nodes each comprising a wireless communications device and a controller connected thereto;

said controller operating in accordance with a multi-layer protocol hierarchy for,

at an application layer, establishing a quality-of-service (QoS) threshold from among a plurality of different possible QoS thresholds based upon a type of given data to be transmitted to at least one destination node;

at a QoS support layer below the application layer, determining whether to require data reception acknowledgements based upon the QoS threshold;

at a QoS coding layer below the QoS support layer, encoding data from the application layer for transmission to the at least one destination mobile node;

at a QoS route selection layer below the QoS coding layer, selecting at least one route to the at least one destination mobile node based upon the QoS threshold;

at a QoS traffic layer below the QoS route selection layer, controlling data traffic flow based upon the QoS threshold; and

at at least one lower protocol layer below the QoS traffic layer, cooperating with said wireless communications device to transmit the given data to the at least one destination mobile node via the at least one selected route.

2. (Original) The MANET of Claim 1 wherein, at a QoS forwarding layer between the QoS route selection layer and QoS traffic layer, selecting between a unicast communications mode and a multicast communications mode based upon the QoS threshold; and wherein, at the at least one lower protocol layer, said controller cooperates with said wireless communications device to transmit the data based upon the selected communications mode.

3. (Original) The MANET of Claim 1 wherein the at least one lower protocol layer comprises a radio adaptation layer providing an interface for the QoS traffic layer.

4. (Original)The MANET of Claim 1 wherein the at least one lower protocol layer comprises a media access layer.

5. (Original) The MANET of Claim 1 wherein the at least one lower protocol layer comprises a physical layer.

6. (Original) The MANET of Claim 5 wherein, at the physical layer, said controller cooperates with said wireless communications device to determine a QoS metric for the at least

one selected route; wherein, at the QoS route selection layer, said controller determines whether the QoS metric falls below the QoS threshold; and wherein, at the physical layer, said controller cooperates with said wireless communications device to adjust at least one signal characteristic based upon a determination that the QoS metric has fallen below the QoS threshold.

7. (Original) The MANET of Claim 6 wherein the at least one signal characteristic comprises at least one of power, gain, and signal pattern.

8. (Original) The MANET of Claim 1 wherein, at the QoS support layer, said controller determines whether to admit traffic from other mobile nodes based upon respective QoS route requests received therefrom and an internal QoS metric.

9. (Original) The MANET of Claim 8 wherein the QoS route requests have respective traffic flow identifiers and second QoS thresholds associated therewith; and wherein, at the QoS traffic layer, said controller further polices admitted traffic based upon respective traffic flow identifiers to ensure that the admitted traffic does not exceed respective second QoS thresholds.

10. (Original) The MANET of Claim 8 wherein the internal QoS metric comprises at least one of available power,

available bandwidth, recent error rate, and recent delay.

11. (Original) The MANET of Claim 1 wherein, at the QoS packet coding layer, said controller:

encodes data using a forward error correction (FEC) algorithm to generate error correction data for the data based upon the QoS threshold, and

interleaves the error correction data and the data prior to transmission thereof.

12. (Original) The MANET of Claim 1 wherein, at the QoS route selection layer, said controller performs load-leveling on outgoing data based upon the QoS threshold and an energy usage level required to transmit the outgoing data.

13. (Original) The MANET of Claim 1 wherein said wireless communications device operates over a plurality of channels; wherein the selected route is associated with one of the plurality of channels; and wherein, at the at least one lower protocol layer, said controller cooperates with said wireless communications device to scout at least one other available channel when a QoS level of the selected route falls below the QoS threshold.

14. (Previously presented) A mobile ad hoc network (MANET) comprising:

a plurality of mobile nodes each comprising a wireless

communications device and a controller connected thereto;

said controller operating in accordance with a multi-layer protocol hierarchy for,

at an application layer, establishing a quality-of-service (QoS) threshold from among a plurality of different possible QoS thresholds based upon a type of given data to be transmitted to at least one destination node;

at a QoS support layer below the application layer, determining whether to require data reception acknowledgements based upon the QoS threshold;

at a QoS coding layer below the QoS support layer, encoding data from the application layer for transmission to the at least one destination mobile node;

at a QoS route selection layer below the QoS coding layer, selecting at least one route to the at least one destination mobile node based upon the QoS threshold;

at a QoS traffic layer below the QoS route selection layer, controlling data traffic flow based upon the QoS threshold;

at a physical layer below the QoS traffic layer, cooperating with said wireless communications device to transmit the given data to the at least one destination mobile node via the at least one selected route; and

at a radio adaptation layer between the physical layer below the QoS traffic layer, providing an interface between the physical device and QoS traffic layer.

15. (Original) The MANET of Claim 14 wherein, at a QoS forwarding layer between the QoS route selection layer and QoS traffic layer, selecting between a unicast communications mode and a multicast communications mode based upon the QoS threshold; and wherein, at the at least one lower protocol layer, said controller cooperates with said wireless communications device to transmit the data based upon the selected communications mode.

16. (Original) The MANET of Claim 14 wherein, at a media access layer between the radio adaptation layer and the physical layer, said controller performs media access operations.

17. (Original) The MANET of Claim 14 wherein, at the physical layer, said controller cooperates with said wireless communications device to determine a QoS metric for the at least one selected route; wherein, at the QoS route selection layer, said controller determines whether the QoS metric falls below the QoS threshold; and wherein, at the physical layer, said controller cooperates with said wireless communications device to adjust at least one signal characteristic based upon a determination that the QoS metric has fallen below the QoS threshold.

18. (Original) The MANET of Claim 17 wherein the at least one signal characteristic comprises at least one of power, gain, and signal pattern.

19. (Original) The MANET of Claim 14 wherein, at the QoS support layer, said controller determines whether to admit traffic from other mobile nodes based upon respective QoS route requests received therefrom and an internal QoS metric.

20. (Original) The MANET of Claim 19 wherein the QoS route requests have respective traffic flow identifiers and second QoS thresholds associated therewith; and wherein, at the QoS traffic layer, said controller further polices admitted traffic based upon respective traffic flow identifiers to ensure that the admitted traffic does not exceed respective second QoS thresholds.

21. (Original) The MANET of Claim 19 wherein the internal QoS metric comprises at least one of available power, available bandwidth, recent error rate, and recent delay.

22. (Original) The MANET of Claim 14 wherein, at the QoS packet coding layer, said controller:

encodes data using a forward error correction (FEC) algorithm to generate error correction data for the data based upon the QoS threshold, and

interleaves the error correction data and the data prior to transmission thereof.

23. (Original) The MANET of Claim 14 wherein, at the QoS route selection layer, said controller performs load-leveling on outgoing data based upon the QoS threshold and an energy usage level required to transmit the outgoing data.

24. (Original) The MANET of Claim 14 wherein said wireless communications device operates over a plurality of channels; wherein the selected route is associated with one of the plurality of channels; and wherein, at the at least one lower protocol layer, said controller cooperates with said wireless communications device to scout at least one other available channel when a QoS level of the selected route falls below the QoS threshold.

25. (Previously presented) A method for operating a mobile node in a mobile ad hoc network (MANET), comprising a plurality of mobile nodes, in accordance with a multi-layer protocol hierarchy, the mobile node comprising a wireless communications device, and the method comprising:

at an application layer, establishing a quality-of-service (QoS) threshold from among a plurality of different possible QoS thresholds based upon a type of given data to be transmitted to at least one destination node;

at a QoS support layer below the application layer, determining whether to require data reception acknowledgements based upon the QoS threshold;

at a QoS coding layer below the QoS support layer, encoding data from the application layer for transmission to the at least one destination mobile node;

at a QoS route selection layer below the QoS coding layer, selecting at least one route to the at least one destination mobile node based upon the QoS threshold;

at a QoS traffic layer below the QoS route selection layer, controlling data traffic flow based upon the QoS threshold; and

at at least one lower protocol layer below the QoS traffic layer, causing the wireless communications device to transmit the given data to the at least one destination mobile node via the at least one selected route.

26. (Original) The method of Claim 25 further comprising, at a QoS forwarding layer between the QoS route selection layer and QoS traffic layer, selecting between a unicast communications mode and a multicast communications mode based upon the QoS threshold; and wherein cooperating comprises cooperating with the wireless communications device to transmit the data based upon the selected communications mode.

27. (Original) The method of Claim 25 wherein the at least one lower protocol layer comprises a radio adaptation layer

for providing an interface for the QoS traffic layer.

28. (Original) The method of Claim 25 wherein the at least one lower protocol layer comprises a media access layer.

29. (Original) The method of Claim 25 wherein the at least one lower protocol layer comprises a physical layer.

30. (Original) The method of Claim 29 further comprising:

at the physical layer, cooperating with the wireless communications device to determine a QoS metric for the at least one selected route;

at the QoS route selection layer, determining whether the QoS metric falls below the QoS threshold; and

at the physical layer, the cooperating with the wireless communications device to adjust at least one signal characteristic based upon a determination that the QoS metric has fallen below the QoS threshold.

31. (Original) The method of Claim 30 wherein the at least one signal characteristic comprises at least one of power, gain, and signal pattern.

32. (Original) The method of Claim 25 further comprising, at the QoS support layer, determining whether to admit traffic from other mobile nodes based upon respective QoS

route requests received therefrom and an internal QoS metric.

33. (Original) The method of Claim 32 wherein the QoS route requests have respective traffic flow identifiers and second QoS thresholds associated therewith; and further comprising, at the QoS traffic layer, policing admitted traffic based upon respective traffic flow identifiers to ensure that the admitted traffic does not exceed respective second QoS thresholds.

34. (Original) The method of Claim 32 wherein the internal QoS metric comprises at least one of available power, available bandwidth, recent error rate, and recent delay.

35. (Original) The method of Claim 25 further comprising, at the QoS packet coding layer:

encoding data using a forward error correction (FEC) algorithm to generate error correction data for the data based upon the QoS threshold, and

interleaving the error correction data and the data prior to transmission thereof.

36. (Original) The method of Claim 25 further comprising, at the QoS route selection layer, performing load-leveling on outgoing data based upon the QoS threshold and an energy usage level required to transmit the outgoing data.

37. (Original) The method of Claim 25 wherein the wireless communications device operates over a plurality of channels; wherein the selected route is associated with one of the plurality of channels; and further comprising, at the at least one lower protocol layer, cooperating with the wireless communications device to scout at least one other available channel when a QoS level of the selected route falls below the QoS threshold.

REMARKS

The Examiner is thanked for the thorough examination of the present application. In view of the arguments presented in detail below, it is submitted that all of the claims are patentable.

I. The Claimed Invention

The present invention is directed to a mobile ad hoc network (MANET). As recited in independent Claim 1, for example, the MANET includes a plurality of mobile nodes each including a wireless communications device and a controller connected thereto. The controller operates in accordance with a multi-layer protocol hierarchy. At an application layer, the controller establishes a quality-of-service (QoS) threshold from among a plurality of different possible QoS thresholds based upon a type of given data to be transmitted to at least one destination node. At a QoS support layer below the application layer, the controller determines whether to require data reception acknowledgements based upon the QoS threshold. At a QoS coding layer below the QoS support layer, the controller encodes data from the application layer for transmission to the at least one destination mobile node. At a QoS route selection layer below the QoS coding layer, the controller selects at least one route to the at least one destination mobile node based upon the QoS threshold. Moreover, at a QoS traffic layer below the QoS route selection layer, the controller controls data traffic flow based upon the QoS threshold. In addition, at at least one lower

protocol layer below the QoS traffic layer, the controller cooperates with the wireless communications device to transmit data to the at least one destination mobile node via the at least one selected route.

Independent Claim 14 is directed to a similar MANET, and independent Claim 25 is directed to a related method for operating a mobile node in a MANET. Each of these claims recites establishing a QoS threshold from among a plurality of different possible QoS thresholds based upon a type of given data to be transmitted to at least one destination node at an application layer as in Claim 1.

II. The Claims Are Patentable

The Examiner rejected independent Claims 1, 14, and 25 over U.S. Patent No. 6,629,151 to Bahl in view of U.S. Patent No. 6,832,249 to Ciscon et al. Bahl is directed to a wireless LAN system in which network layer interfaces perform static and dynamic queries, as well as requests to set attributes. While the Examiner correctly acknowledges that Bahl fails to teach or fairly suggest establishing a QoS threshold from among a plurality of different possible QoS thresholds based upon a type of given data to be transmitted to at least one destination node at an application layer, he contends that Ciscon et al. provides this noted deficiency. Ciscon et al. is directed to a method for providing broadband communications over a multi-protocol layer wired network (i.e., the Internet). As support for his contention, the Examiner points to col. 10 of this reference

which discusses a network monitor that monitors communication resources of various network elements searching for QoS events.

It is respectfully submitted that the selective combination of references fails to teach or fairly suggest all of the recitations of the above-noted independent claims. As an initial matter, while the above-noted text of Ciscon et al. discusses that different types of QoS metrics may be used, and that the way in which "error seconds" are determined may be changed based upon the given implementation, nowhere does this or any other passage in Ciscon et al. teach or fairly suggest establishing one of a plurality of QoS thresholds based upon a given type of data to be transmitted, as recited in the above-noted independent claims.

Moreover, neither of the cited references has anything to do with MANETs or performing routing in complex MANET environments. Bahl is directed to querying dynamic aspects of wireless connections in a wireless LAN. An existing wireless LAN typically includes a fixed network with one or more access points connected thereto, and wireless clients or devices access the fixed network via the access points over wireless links. A wireless LAN may have a basic peer-to-peer or "ad hoc" mode, as generally noted at col. 16, lines 6-22 of Bahl. In this mode, wireless devices within range of each other discover and communicate in peer-to-peer fashion without involving central access points. Ciscon et al. is concerned with wired network communications and control operations and is therefore even farther removed from the MANET environment.

In contrast, a MANET is a network that is formed of mobile (and potentially stationary) nodes, and is created on the fly as the nodes communicate with each other. The network does not depend on a particular node and dynamically adjusts as some nodes join or others leave the network. As discussed in the background of the present application (see, e.g., paragraphs 0002-0005 of the originally filed specification), because MANETs lack a fixed infrastructure, nodes must self-organize and reconfigure as they move, join or leave the network. All nodes are essentially the same, and there is no natural hierarchy or central controller in the network. All functions may be distributed among the nodes. Nodes are often powered by batteries and have limited communication and computation capabilities. Also, the bandwidth of the system is usually limited. The distance between two nodes often exceeds the radio transmission range, and a transmission may have to be relayed by other nodes before reaching its destination. Consequently, a MANET network typically has a multi-hop topology, and this topology changes as the nodes move around.

Moreover, there is simply no proper motivation or suggestion to combine the references as the Examiner proposes. More particularly, Ciscon et al. addresses QoS issues in a wired network context, in that it proposes methods for monitoring QoS events to allow a response to be formulated (e.g., by provisioning additional circuits) that will improve or maintain a desired level of QoS. Bahl simply formulates mechanisms by which a software system can interface with a wireless device for the

purpose of extracting status or to set parameters.

Further, while the Ciscon patent proposes some methods for controlling QoS in a wired system, these methods cannot be easily adapted to wireless systems. Achieving desired QoS in a wireless environment involves the use of domain-specific wireless knowledge to control the allocation of resources to balance QoS and network capacity by controlling wireless-specific signal and radio coverage characteristics. Yet, neither Bahl nor Ciscon provides guidance or direction as to how this could be accomplished.

Moreover, QoS in a conventional wired network is primarily concerned with the avoidance and management of traffic congestion arising from the delay of packets due to buffering by routers and switches, and transmission delays over cable and wire links. QoS in a wireless network is more involved and requires accounting for bit errors due to low signal-to-noise ratio, and lost packets due to outages caused by attenuation, interference, blockages, etc., which are typically not encountered in the wired network context.

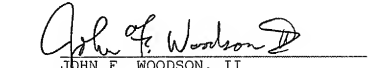
As such, since neither of the above-noted references teaches or fairly suggest applying the principles thereof to a MANET, or how to perform the claimed QoS operations in any wireless network, one of ordinary skill in the art would not have been motivated to combine the references as the Examiner proposes. Since the remaining prior art of record fails to provide the above-noted deficiencies, taking all of the teachings of the prior art as a whole, the prior art simply fails to teach

or fairly suggest all of the recitations of independent Claims 1, 14, and 25. Accordingly, it is submitted that these claims are patentable over the prior art. Their respective dependent claims, which recite yet further distinguishing features, are also patentable over the prior art and require no further discussion herein.

CONCLUSIONS

In view of the foregoing, it is submitted that all of the claims are patentable. Accordingly, a Notice of Allowance is respectfully requested in due course. Should any minor informalities need to be addressed, the Examiner is encouraged to contact the undersigned attorney at the telephone number listed below.

Respectfully submitted,



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